



Namal University, Mianwali

Department of Electrical Engineering

Communication Systems (Lab)

Lab – 7

Frequency Modulation and Demodulation

Student Name	Student ID

Instructor: Dr. Sajjad Ur Rehman

Lab Engineer: Faizan Ahmad

Introduction

The purpose of this lab is to enable the students to write a code for frequency modulation and Demodulation using MATLAB. The students will also observe the modulation and demodulation using Communication Trainer, CT-3000.

Course Learning Outcomes

CLO1: Perform hardware experiments for modulation/ demodulation techniques as well as sampling of analog signals.

CLO2: Develop software simulations to observe the performance of analog and digital communication systems.

CLO4: Report desired results proofs and calculations.

Equipment

- Software
 - MATLAB

Instructions

- This is an individual lab. You will perform the tasks individually and submit the required files at the end of the lab.
- Plagiarism or any hint thereof will be dealt with strictly. Any incident where plagiarism is caught, both (or all) students involved will be given zero marks, regardless of who copied whom. Multiple such incidents will result in disciplinary action being taken.

Frequency Modulation

In Amplitude Modulation schemes, the amplitude of a carrier signal varies with the amplitude of the message signal. Therefore the information of the message is stored in the amplitude of the carrier.

As studied in class, two other parameters of the carrier signal, i.e. frequency and phase can also store the information content of the message signal, and the resulting modulation schemes are called frequency modulation and phase modulation respectively. They are also collectively known as angle modulation.

The generalized form of an angle modulated signal is given mathematically as

$$M(t) = A_c \cos(2\pi f_c t + \phi(t))$$

Where

$$\phi(t) = 2\pi k_f \int_{-\infty}^t m(\tau) d\tau \text{ for FM}$$

In frequency modulation, the frequency rather than the amplitude of the carrier wave is made to vary in proportion to the varying amplitude of the modulating signal. A simple method to achieve FM is to vary the capacitance of a resonant LC circuit in a transmitter. Because the frequency of a radio wave is less vulnerable to noise than the amplitude, FM was originally introduced to reduce noise and improve the quality of radio reception.

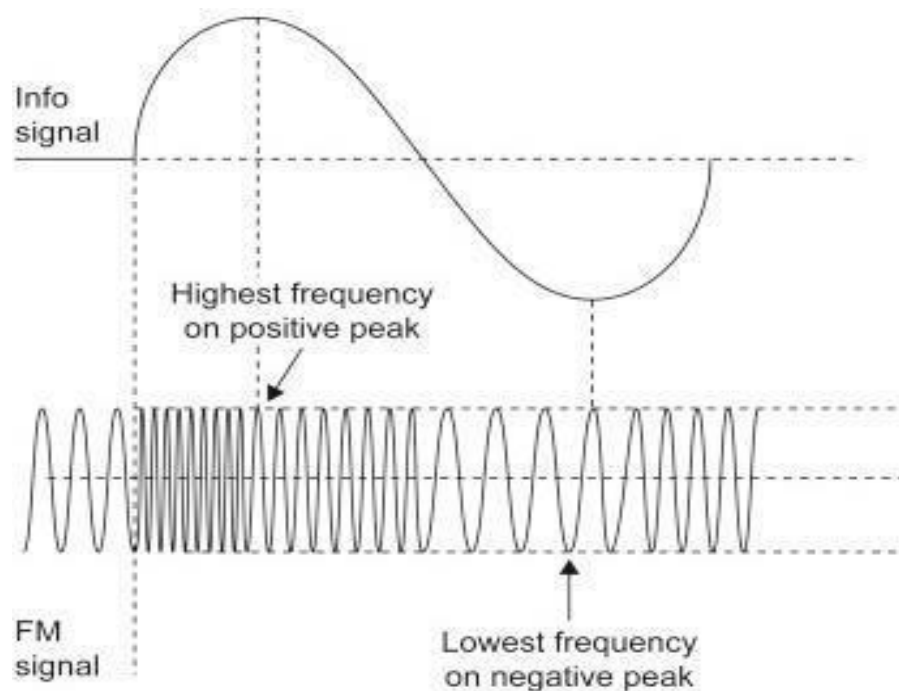


Figure: Frequency modulation demonstration

Task 1 – Frequency Modulation and Demodulation using MATLAB

The MATLAB function for Frequency modulation is `fmmod` () and the one for frequency demodulation is `fmdemod` ()

Exercise 1

- Write a MATLAB code to modulate a sinusoidal signal ($A_m \cos(2\pi f_m t + \theta)$) using frequency modulation.
- Use $f_m=10\text{Hz}$, $A_m=1$, $\theta_m=0$, $f_s=10000$, $f_c=500$, $A_c=1$, $\theta_c=0$, $f_{\text{dev}}=250$.
- After defining the message signal frequency, carrier frequency, and the sampling frequency, the time scale can be defined as $t = 0:1/f_s:0.1$; for one time period of the message signal.
- Display the input signal, the modulated signal as well as the magnitude spectrum of input signal and Demodulated signal.
- Label all plots properly.

Change the value of frequency deviation factor and observe its effect on the modulated and recovered (demodulated) signal. Write your observations.

Task 2 – Hardware

Procedure

- First of all energize CT-3000 communication Trainer by applying $220V_{AC}$.
- For frequency modulation and demodulation, FM module is inserted in socket 4 and FM Carrier synchronizer module is inserted in socket 2.
- Set the message signal AF of 1 KHz and carrier signal RF of 10MHz directly from trainer at J1 port of FM module.
- Then, frequency modulated signal is observed, at J2 of FM module, on oscilloscope by using prob.
- Now, J2 of FM module is connected to J1 of FMCS module by using connecting wire and demodulated signal is observed at J2 on oscilloscope by using prob. Show the output to an instructor.
- Observations:

Report

For each exercise, include the code you write, explanation where asked, all outputs, as well as answers to any questions, as required. Upload your final report (containing general formalities like cover page containing your name and roll number etc.) to QOBE in the report submission folder.

Upload your final report in the separate submission folder on QOBE.

Com. Sys. Lab 7 Rubric**Method of Evaluation:** Executable code, Report submitted by students **Measured****Learning Outcomes:**

CLO1: Operate under supervision and practice hardware experiments for modulation/demodulation techniques as well as sampling of analog signals..

CLO2: Develop software simulations to observe the performance of analog and digital communications systems.

CLO4: Report desired results proofs and calculations.

	Excellent 10	Good 9-7	Satisfactory 6-4	Unsatisfactory 3-1	Poor 0	Marks Obtained
Hardware Experiment (CLO1)	Excellent performance in hardware experiments for modulation	Good performance but lack of understanding	Slightly incorrect Hardware setup with proper understanding	Bad performance in hardware experiment	Experiment not performed	
Code (CLO2)	Correct code, easily understandable with comments where necessary	Correct code but without proper indentation or comments	Slightly incorrect code with proper comments	Incorrect code with improper format and no comments	Code not submitted	
Output (CLO2)	Output correctly shown with all Figures/ Plots displayed as required and properly labelled	Most Output/ Figures/ Plots displayed with proper labels	Some Output/ Figures/ Plots displayed with proper labels OR Most Output/ Figures/ Plots displayed but without proper labels	Most of the required Output/ Figures/ Plots not displayed	Output/ Figures/ Plots not displayed	
Answers (CLO2)	Meaningful answers to all questions. Answers show the understanding of the student.	Meaningful answers to most questions.	Some correct/ meaningful answers with some irrelevant ones	Answers not understandable/ not relevant to questions	Wrong Answers	
Lab Report (CLO4)	Report submitted with proper grammar and punctuation with proper conclusions drawn and good formatting	Report submitted with proper conclusions drawn with good formatting but some grammar mistakes OR proper grammar but not very good formatting	Some correct/ meaningful conclusions. Some parts of the document not properly formatted or some grammar mistakes	Conclusions not based on results. Bad formatting with no proper grammar/ punctuation	Report not submitted	
Total						

